

## **REMARKS**

Applicants have amended claims 19, 21, 23, and 26-28 to correct obvious typographical errors. Claims 30 and 35-37 have been amended, claim 31 has been cancelled, and new claim 42 has been added. Support for the claim amendments and new claim can be found at least in Figures 3A and 3B and related text and in the originally filed claims. No new matter has been added.

Claims 2, 4-6, 9-13, and 19-41 stand rejected under the judicially created doctrine of obviousness-type double patenting over claims of commonly owned U.S. Patent No. 6,719,843. Applicants herewith submit a Terminal Disclaimer to address this rejection.

### **Rejection of Claims under 35 U.S.C. § 103**

Claims 30-41 are rejected under 35 U.S.C. § 103(a) as being unpatentable over “Properties of Crucible Materials for Bulk Growth of AlN,” Mat. Res. Soc. Symp. Proc. Vol. 798, pp. Y10.74.1-4 (2004) to Slack et al. (“Slack”). Independent claim 30 has been amended to include the limitations of claim 31 as filed, and claim 31 has been cancelled. Independent claim 35 has been amended to more clearly define the subject matter Applicants define as their invention.

Applicants respectfully submit that Slack does not teach all of the limitations of independent claim 30 as amended. Moreover, it would not have been obvious to one of ordinary skill in the art to fabricate an aluminum nitride crystal wherein, during heating of the crucible, grains of an outer layer swell to substantially obstruct diffusion of aluminum, as recited in amended claim 30.

Slack discloses candidate materials for use as crucibles for growth of aluminum nitride single crystals, as well as their materials properties. *See* Slack, abstract. Slack is utterly silent as to not only the microstructural behavior of a particular crucible during the formation of an aluminum nitride boule, but also the problem solved by Applicants’ invention. As emphasized in the Specification, prior-art crucibles possess a columnar grain structure which enables pinhole leaks of corrosive aluminum vapor to form during formation of aluminum nitride boules. *See* Specification, Figures 2A and 2B and related text. Applicants therefore utilize a fundamentally

different method to form aluminum nitride. Specifically, the grains of a second, outer crucible layer swell to obstruct the diffusion of aluminum along diffusion pathways defined by grain boundaries in the first, inner layer, as recited in independent claim 30 as amended. Applicants' method provides the unexpected benefit of preventing premature crucible failure. *See* Specification, Figures 3A and 3B and related text. Slack, therefore, does not even address the problem solved by the present invention. One of ordinary skill in the art would not even be motivated, based on Slack, to solve this problem—certainly not by utilizing the specific approach recited in claim 30. Applicants respectfully submit that the rejection of claim 30 should be withdrawn.

Applicants respectfully submit that independent claim 32 is also patentable over the cited art. Without acquiescing to the rejection of claims 33 and 34, Applicants note that these claims depend directly from claim 32, and include all the limitations thereof, and thus are also patentable. For at least the following reasons, reconsideration and withdrawal of the rejection of claims 32-34 under 35 U.S.C. §103(a) is respectfully requested.

Slack simply does not teach all of the limitations of independent claim 32. As explained above, Slack is silent as to the microstructure of crucibles used for the single-crystal growth of aluminum nitride. Rather, Slack discloses materials choices for crucibles without contemplating the problem of pinhole leaks solved by Applicants' invention. The Examiner asserts that the crucible recited in independent claim 32 is rendered obvious by Slack. Applicants respectfully disagree. Other types of crucibles can be utilized to form aluminum nitride boules but develop pinhole leaks expressly because diffusion pathways in such crucibles are not obstructed, as required in independent claim 32. *See* Specification, Figures 2A and 3B and related text. Since Slack is silent as to crucible microstructure or the problem of pinhole leakage, a claim of obviousness can only be based on Applicants' disclosure, representing impermissible hindsight on the part of the Examiner.

Applicants respectfully submit that independent claim 35 is patentable over the cited art. Without acquiescing to the rejection of claims 36-41, Applicants note that these claims depend directly or indirectly from claim 35, and include all the limitations thereof, and thus are also patentable. For at least the following reasons, reconsideration and withdrawal of the rejection of claims 35-41 under 35 U.S.C. §103(a) is respectfully requested.

In particular, an aluminum nitride single-crystal boule tapered to a diameter greater than about 20 mm, as recited in independent claim 35 as amended, would not have been obvious to or even attainable by one of ordinary skill in the art limited to the use of prior-art crucibles for aluminum nitride manufacture. As emphasized in Applicants' disclosure, the maximum achievable crystal size for single-crystal aluminum nitride boules was limited by deleterious pinhole leaks of aluminum during aluminum nitride growth that caused crucible failure. The limited lifetime of prior art crucibles, combined with slow rates of aluminum nitride single crystal growth, rendered boules tapered to 20 mm or more unattainable. *See* Specification, page 2, lines 17-21 and page 5, lines 17-21. Slack utterly fails to address the problem with prior art crucibles limiting aluminum nitride boules to small sizes, and therefore teaches nothing that would permit formation of the large-size boules recited in claim 35. Such boules are, quite simply, unobtainable based on Slack's teaching, and Slack therefore cannot serve as a proper reference against claims 35-41.

### CONCLUSION

In light of the foregoing, Applicants respectfully submit that all claims are now in condition for allowance.


A check for \$65 is enclosed for the Terminal Disclaimer fee. Applicants believe that no additional fees are necessitated by the present Response. However, in the event that any additional fees are due, the Commissioner is hereby authorized to charge any such fees to Deposit Account No. 07-1700.

If the Examiner believes that a telephone conversation with Applicants' agent would expedite allowance of this application, the Examiner is cordially invited to call the undersigned agent at (617) 570-1198.

Respectfully submitted,

Date: August 29, 2006  
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